PATENT ABSTRACTS OF JAPAN

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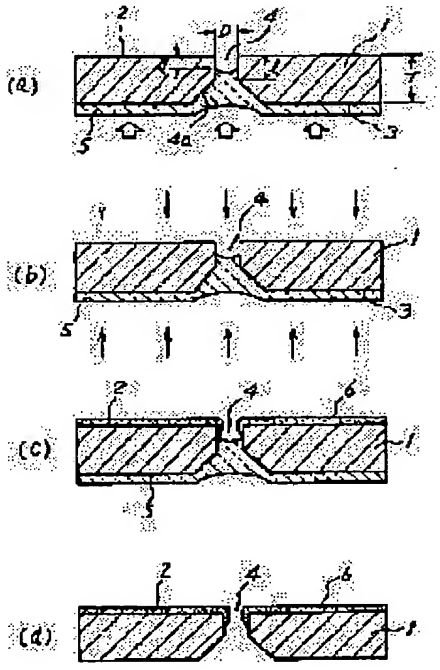
(54) NOZZLE PLATE OF INK JET PRINTER AND PRODUCTION THEREOF

(57)Abstract:
PURPOSE: To stabilize the ejection of an ink droplet by allowing a part of an ink repelling coating layer to reach the inner surface of a nozzle so that the gap volume in the nozzle becomes a specific range with respect to the amt. of ink to be emitted.
CONSTITUTION: A part of the ink repelling coating layer applied to the surface of a nozzle plate 1 is allowed to reach the inner surface of a nozzle 4 so that the gap volume in the nozzle 4 from the surface of the nozzle plate 1 to the meniscus forming surface thereof becomes the range of 0.05-0.50 with respect to the ejected amt. of ink. Concretely, the rear surface 3 and the upper surface 2 of the nozzle plate 1 are irradiated with infrared rays to cure the photosensitive resin film 5 applied to the rear surface 3 of the nozzle plate 1 and the inner surface of the nozzle 4. Next, the nozzle plate 1 is dipped in a water repelling resin particle dispersion to form a coprecipitation plating layer 6. Further, the resin film 5 applied to the rear surface 3 of the nozzle plate 1 and the inner surface of the nozzle 4 is dissolved and removed by a solvent and, thereafter, the nozzle plate is overheated at predetermined temp. to form an ink repelling plating layer 6.



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CLAIMS

[Claim(s)]
[Claim 1] The nozzle plate of the ink jet printer characterized by making a part of ** ink nature enveloping layer which covers the front face of the above-mentioned nozzle plate enter into the inside of the above-mentioned nozzle so that it may become the range of 0.05 or 0.50 from the front face of a nozzle plate to the amount of ink which the opening capacity in a nozzle to a meniscus forming face makes breathe out.
[Claim 2] The nozzle plate of the ink jet printer according to claim 1 characterized by forming a ****** ink nature enveloping layer by eutectoid plating.
[Claim 3] The nozzle plate of the ink jet printer characterized by forming a ****** ink nature enveloping layer by fluorine system macromolecule resin material other than the above-mentioned eutectoid plating.
[Claim 4] The nozzle plate manufacture method of an ink jet printer characterized by providing the following. The process which makes a part of this photopolymer material enter in a nozzle to a position where the opening capacity in a nozzle from the front face of a nozzle plate becomes 0.05 or 0.50 to the amount of ink which carries out the pressure welding of the photopolymer material to the rear face of a nozzle plate, and applies heat to this photopolymer material, and is made to breathe out. The process which forms the enveloping layer of ** ink nature in the inside of the above-mentioned nozzle, and the front face of the above-mentioned nozzle plate for this photopolymer material that was made to harden this photopolymer material by light, and subsequently hardened it at least as masking material.
[Claim 5] The nozzle plate manufacture method of the ink jet printer according to claim 4 characterized by making it control by changing temperature into the nozzle of the above-mentioned photopolymer material after entering and fixing a pressure for an amount.
[Claim 6] The nozzle plate manufacture method of an ink jet printer characterized by providing the following. The process into which carry out the laminating of the elastic material on the surface of a nozzle plate, and pressurize this elastic material, and a part of this elastic material is made to enter into a nozzle to the amount of ink made to breathe out to a position into the nozzle from a nozzle plate front face where it enters and an amount becomes 0.05 or 0.50. The process which forms a masking layer in the rear face of the above-mentioned nozzle plate as dashes at least a part against the above-mentioned elastic material in a nozzle, and the process which removes the above-mentioned elastic material, subsequently carries out the above-mentioned masking layer as masking material, and forms the enveloping layer of ** ink nature in the inside of the above-mentioned nozzle, and the front face of the above-mentioned nozzle plate at least.
[Claim 7] The nozzle plate manufacture method of the ink jet printer according to claim 6 characterized by forming the above-mentioned masking layer by photopolymer material.
[Claim 8] The nozzle plate manufacture method of the ink jet printer characterized by forming the above-mentioned masking layer with a plasticizer.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the nozzle plate and its manufacture method of an ink jet printer.
[0002]
[Description of the Prior Art] In the ink jet printer of the form which writes in a record image on a record medium by the ink drop made to breathe out from a nozzle, the ink drop has the problem of producing gap in the flight direction by wetting of the ink of the state of the circumference of a nozzle, i.e., the circumference of a nozzle.
[0003] By sputtering, the nozzle plate indicated by JP,57-107848,A to such a problem forms ** ink nature coats, such as a fluororesin, in the inside of a nozzle, and the front face of a nozzle plate uniformly, and stops wetting of the ink of the circumference of a nozzle.
[0004] Since it is made for wetting of ink not to produce this thing in the circumference of a nozzle, although it has the advantage which can make an ink drop fly stably in the direction of an axis of a nozzle Since the ** ink sex-skin film to a nozzle inside enters by the formation technique of the ** ink sex-skin film of this thing and an amount is not fixed on the other hand, when an amount is too large, by entering The result to which the oscillating center of a meniscus separates from the front face of the part nozzle plate, The energy needed in order to make the ink of a necessary amount breathe out becomes large, and regurgitation efficiency becomes bad, and by entering, when there are too few amounts As a result of the oscillating center of a meniscus becoming near the front face of a nozzle plate, it produces saying that an ink drop carries out the re-regurgitation by vibration of the meniscus after an ink drop breathes out, starting the so-called misfire, etc. with [big] a rose for every product, and the problem of spoiling reliability arises.
[0005]
[Problem(s) to be Solved by the Invention] this invention was made in view of such a problem, and the place made into the purpose is by [of the ** ink nature matter to a nozzle inside] entering and holding down an amount to a certain fixed range to offer the new nozzle plate which makes stable **** of an ink drop realize.
[0006] Moreover, the place made into other purposes of this invention is to propose the manufacture method of the new nozzle plate into the nozzle of a ** ink sex-skin film which enters and can stop an amount within the limits of predetermined.
[0007]
[Means for Solving the Problem] That is, it is made for this invention to make a part of ** ink nature enveloping layer which covers the front face of a nozzle plate enter into the inside of a nozzle so that it may become the range of 0.05 or 0.50 from the front face of a nozzle plate to the amount of ink which the opening capacity in a nozzle to a meniscus forming face makes breathe out as a nozzle plate of the ink jet printer for attaining such a technical problem.
[0008] Moreover, the pressure welding of the photopolymer material is carried out to the rear face of a nozzle plate as the manufacture method of the nozzle plate for it. A part of this photopolymer material is made to enter in a nozzle to a position where the opening capacity in a

nozzle from the front face of a nozzle plate becomes 0.05 or 0.50 to the amount of ink which makes this photopolymer material apply and breathe out heat. and subsequently This photopolymer material is stiffened by light and the enveloping layer of ** ink nature is formed in the inside of a nozzle, and the front face of a nozzle plate for this at least as masking material.
[0009]
[Example] Then, the example illustrated below is explained. The surface treatment process is shown in more detail, and drawing 1 shows drawing 2 and drawing 3 about the manufacturing process of the nozzle plate which makes one example of this invention, and the nozzle plate formed of this process.
[0010] The nozzle plate shown with the sign 1 in drawing It is formed by a metal, ceramics, silicon, glass, plastics, etc. Preferably Titanium, chromium, iron, cobalt, nickel, copper, zinc, tin, Single material, such as gold, or a nickel–Lynn alloy, a tin–copper–Lynn alloy (phosphor bronze), Alloys, such as a copper–zinc alloy and stainless steel, and a polycarbonate, a pulley ape phon, ABS plastics (acrylic nitril styrene–butadiene–rubber ******), a polyethylene terephthalate, two or more nozzles which are formed by the polyacetal and various kinds of photopolymer material, and become tubed from orifice partial 4b which carried out opening at funnel–like partial 4a which carried out opening to the rear–face 3 side greatly at this nozzle plate 1, and a front–face 2 side — the hole 4 is formed
[0011] In the rear face 2 of this nozzle plate 1, the dry film resist of die YARON FRA 305–38 (tradename) made from Mitsubishi rayon is first laminated as the photopolymer film 5 hardened by light, and an example. subsequently They are 4.0 kgf/cm2 to this photopolymer film 5. It heats at the temperature around 40–70 degrees C, applying a pressure, and some films 5 are made to enter the interior of a nozzle 5 from a front face to a place with a depth of 5–40 micrometers (drawing 1 (a)).
[0012] Next, ultraviolet rays are irradiated from the rear face 3 and front face 2 of a nozzle plate 1, and the optical photopolymer film 5 whole which entered into the rear face 3 of a nozzle plate 1 and the nozzle 4 is stiffened (this drawing (b)).
[0013] This process is positioned as a head end process for [the / which enters and regulates an amount d] making the eutectoid deposit 6 enter into a nozzle 4 at the following eutectoid deposit formation process.
[0014] Since the viscosity generally changes with temperature a lot, in order for this photopolymer material used in order for this deposit 6 to enter and to regulate an amount d to make some photopolymer films 5 enter in a nozzle 4 to a necessary amount of lumps containing deposit d position, the direction which managed the temperature t of heating, i.e., the amount, which fixes the pressure to apply and is applied to the photopolymer film 5 is a best policy.
[0015] In this example, the general nozzle plate T, i.e., board thickness, 80 micrometers, The diameter D of a nozzle sticks on this rear face 3 the photopolymer film 5 whose thickness is 38 micrometers using the nozzle plate 1 40 micrometers and whose length l of the tubed part of a nozzle are 35 micrometers. They are 4.0 kgf/cm2 to this. 5.0 kgf/cm2 When it heated for 20 seconds at the various temperature t, applying a pressure, the relation as temperature t and the photopolymer film 5 entered and shown in drawing 5 between amounts f was obtained.
[0016] On the other hand, in the case of this example, about the quantity of light of the ultraviolet rays (wavelength of 365nm) for stiffening the photopolymer film 5, it is 750 mJ/cm2. Light exposure was required.
[0017] Next, this nozzle plate 1 is immersed into the electrolytic solution which distributed the particle of nickel ion and water–repellent macromolecule resins, such as a polytetrafluoroethylene, by the charge, and the eutectoid deposit 6 is formed in the front face of a nozzle plate 1, stirring liquid (this drawing (c)).
[0018] It is used as what mixed independently resins, such as a polytetrafluoroethylene, a PORIBA fluoro alkoxy butadiene, the poly fluoro vinylidene, the poly fluoro vinyl, and PORIJI perfluoroalkyl fumarate, as fluorine system macromolecule material used for this eutectoid plating processing.
[0019] Although there is especially no limit as a matrix of this deposit 6 and proper metals, such as nickel, copper, silver, zinc, and tin, can be chosen, what surface hardness, such as nickel, a

nickel–cobalt alloy and a nickel–Lynn alloy, and a nickel–boron alloy, is size, and was moreover excellent in abrasion resistance preferably is selected.
[0020] Thereby, the particle of a polytetrafluoroethylene is a wrap uniformly about the inner circumference enclosure of a nozzle 4 to the point of the depth given from the front face 2 of a nozzle plate 1, and the front face 2.
[0021] Dissolution removal of the photopolymer film 5 which entered in the rear face 3 of a nozzle plate 1 and the nozzle 4 after this using the proper solvent is carried out. and subsequently This is heated at the temperature beyond the melting point of a polytetrafluoroethylene, for example, the temperature of 350 degrees C or more, adding a load to a nozzle plate 1 and suppressing generating of the curvature. The deposit 6 of ** ink nature which is a degree of hardness and which becomes size is formed in the front face 2 of a nozzle plate 1, and the inner skin of the nozzle to the point of the given depth (this drawing (d)).
[0022] Therefore, in the nozzle plate 1 constituted in this way, as shown in drawing 2 , the margo inferior in the nozzle 4 of the ** ink nature deposit 6 serves as an important element which determines the oscillating center A of an ink meniscus.
[0023] And if Vm and the capacity from the front face 2 of a nozzle 4 to the front face B of the ink in front of the regurgitation, i.e., the amount of an ink drop made to breathe out, are set to Vi, the opening capacity in a nozzle from the front face 2 of a nozzle 4 to the oscillating center A of a meniscus Although it can make it unnecessary for a deposit 6 to enter, for Vm/Vi to also become small, so that an amount d is small, and to stop low the piezo driver voltage for obtaining the desired amount Vi of regurgitation ink, a driver as nothing as possible, and expensive If it enters and an amount d is made small too much on the other hand, flight deflection will occur so that it may see in drawing 6 and Table 1.
[0024] On the other hand, a deposit 6 enters, in being large, the level–luffing–motion position C of the meniscus after the ink regurgitation becomes [an amount d] deep, the short supply of ink arises in the case of the level luffing motion of the foam from the front face of a nozzle 4, and the following ink drop regurgitation, and it is inducement **** in the poor regurgitation.
[0025] the following result was obtained, when the ** ink nature deposit 6 entered, prepared the nozzle plate 1 of 80 micrometers of board thickness which the amount d was boiled [board thickness] variously and changed it, the on–demand type ink jet printer which takes a piezo drive method equipped with these, the experiment which makes full breathe out the ink drop of 0.1microg/dot for 30 seconds on the response frequency of 5kHz conducted 100 times from the nozzle 4 whose path is 40 micrometers and the flight deflection in that case and the poor regurgitation counted
[Table 1]

d μm	Vm x10^{-14}mm^3	PZT駆動電圧 V	PZT変位ｴﾈﾙｷﾞｰ x10^{7}J	Vm／Vi	飛行曲り発生回数	吐出不良発生回数
0	0	20	4.5	0	62	0
2	0.25	20	4.5	0.025	13	0
4	0.5	21	5.0	0.05	0	0
5	0.6	21	5.0	0.06	0	0
15	1.9	23	6.0	0.19	0	0
40	5.0	26	7.6	0.50	0	0
50	7.5	42	19.8	0.75	0	24
60	9.0	70	55.1	0.90	0	89

[0026] And when the flight deflection of an ink drop increased rapidly when the ratio of Vm/Vi Vm, i.e., the opening capacity in the nozzle 4 from the front face 2 of the nozzle plate 1 to the amount Vi of an ink drop made to breathe out to the meniscus forming face A, was less than 0.04, and this ratio exceeded 0.50 by this experiment, it turns out that the poor regurgitation occurs rapidly.
[0027] By the way, although the above was an experimental result about a nozzle 4 which has funnel-like partial 4a which carried out opening of the tubed orifice partial 4b to the front-face 2 side greatly at the rear-face 3 side, as shown in drawing 3 , it became clear to have the same inclination as a result of the experiment also about the nozzle 14 which carried out opening to the shape of a trumpet gently to the rear-face 3 side from orifice partial 14b by the side of a front face 2.
[0028] And as for the above thing, it showed [the range of 0.04 or 0.50 and / of the deposit 6] Vm/Vi that what is necessary is to enter and just to define an amount d so that it might become the range of 0.05 or 0.35 more preferably.
[0029] Drawing 4 shows the 2nd example of this invention about the surface treatment method of a nozzle plate 1.
[0030] This method makes the front face 2 of a nozzle plate 1 carry out the pressure welding of the elastic plates 7, such as rubber, first with the necessary press force, and only the amount which necessary enters in a nozzle 4 and is equivalent to an amount d makes the part enter [method]. And next, a dry film resist or the proper plasticizer 8 is applied to the rear-face 3 whole of a nozzle plate 1 as masking material 8 including nozzle 4 portion (drawing 4 (a)).
[0031] Subsequently, when ultraviolet rays are irradiated from a rear face 3, this is stiffened, when a dry film resist is used as masking material 8, and other plasticizers are used, after solidifying this by heating or the usual dryness processing, the elastic material 7 is removed from the front face 2 of a nozzle plate 1 (drawing 4 (b)).
[0032] And next, this nozzle plate 1 is immersed into the electrolytic solution which distributed the particle of a water-repellent macromolecule resin by the charge. or [forming in the front face 2 the enveloping layer 9 of the ** ink nature which consists of an eutectoid deposit] -- or The macromolecule water repellent of a fluorine system is given to the front face 2 of a nozzle plate 1 by the sputtering method or the dipping method (drawing 4 (c)), and it is made to carry out dissolution removal of the masking material 8 at the end from the rear face 3 of a nozzle plate 1 using proper processing liquid (drawing 4 (d)).
[0033]
[Effect of the Invention] Moreover, an ink drop can be made to breathe out with low piezo drive energy as much as possible, without regulating the oscillating position of a meniscus correctly by this enveloping layer, and producing flight deflection and poor ****, since it was made to make a ** ink nature enveloping layer enter in a nozzle so that it may be referred to as 0.05 of the amount of ink which the opening capacity in a nozzle from the front face of a nozzle plate to a meniscus forming face makes breathe out, or 0.50 as stated above according to this invention.
[0034] And a reliable nozzle plate can be formed, without the enveloping layer which regulates the oscillating position of a meniscus entering, being able to manage an amount correctly by this masking material, and making it generated with [for every product] a rose, since the ** ink nature enveloping layer was formed on the surface of the nozzle plate by making into masking material the photopolymer material made to enter in a nozzle from the rear face of a nozzle plate.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] this invention relates to the nozzle plate and its manufacture method of an ink jet printer.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In the ink jet printer of the form which writes in a record image on a record medium by the ink drop made to breathe out from a nozzle, the ink drop has the problem of producing gap in the flight direction by wetting of the ink of the state of the circumference of a nozzle, i.e., the circumference of a nozzle.
[0003] By sputtering, the nozzle plate indicated by JP,57-107848,A to such a problem forms ** ink nature coats, such as a fluororesin, in the inside of a nozzle, and the front face of a nozzle plate uniformly, and stops wetting of the ink of the circumference of a nozzle.
[0004] Since it is made for wetting of ink not to produce this thing in the circumference of a nozzle Although it has the advantage which can make an ink drop fly stably in the direction of an axis of a nozzle Since the ** ink sex-skin film to a nozzle inside enters by the formation technique of the ** ink sex-skin film of this thing and an amount is not fixed on the other hand, when an amount is too large, by entering The result to which the oscillating center of a meniscus separates from the front face of the part nozzle plate, The energy needed in order to make the ink of a necessary amount breathe out becomes large, and **** efficiency becomes bad, and by entering, when there are too few amounts As a result of the oscillating center of a meniscus becoming near the front face of a nozzle plate, it produces saying that an ink drop re-**** by vibration of the meniscus after an ink drop breathes out, starting the so-called misfire, etc. with [big] a rose for every product, and the problem of spoiling reliability arises.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] Moreover, an ink drop can be made to breathe out with low piezo drive energy as much as possible, without regulating the oscillating position of a meniscus correctly by this enveloping layer, and producing flight deflection and poor ****, since it was made to make a ** ink nature enveloping layer enter in a nozzle so that it may be referred to as 0.05 of the amount of ink which the opening capacity in a nozzle from the front face of a nozzle plate to a meniscus forming face makes breathe out, or 0.50 as stated above according to this invention. [0034] And a reliable nozzle plate can be formed, without the enveloping layer which regulates the oscillating position of a meniscus entering, being able to manage an amount correctly by this masking material, and making it generated with [for every product] a rose, since the ** ink nature enveloping layer was formed on the surface of the nozzle plate by making into masking material the photopolymer material made to enter in a nozzle from the rear face of a nozzle plate.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] this invention was made in view of such a problem, and the place made into the purpose is by [of the ** ink nature matter to a nozzle inside] entering and holding down an amount to a certain fixed range to offer the new nozzle plate which makes stable **** of an ink drop realize.
[0006] Moreover, the place made into other purposes of this invention is to propose the manufacture method of the new nozzle plate into the nozzle of a ** ink sex-skin film which enters and can stop an amount within the limits of predetermined.

[Translation done.]

MEANS

[Means for Solving the Problem] That is, it is made for this invention to make a part of ** ink nature enveloping layer which covers the front face of a nozzle plate enter into the inside of a nozzle so that it may become the range of 0.05 or 0.50 from the front face of a nozzle plate to the amount of ink which the opening capacity in a nozzle to a meniscus forming face makes breathe out as a nozzle plate of the ink jet printer for attaining such a technical problem.
[0008] Moreover, the pressure welding of the photopolymer material is carried out to the rear face of a nozzle plate as the manufacture method of the nozzle plate for it. A part of this photopolymer material is made to enter in a nozzle to a position where the opening capacity in a nozzle from the front face of a nozzle plate becomes 0.05 or 0.50 to the amount of ink which makes this photopolymer material apply and breathe out heat. and subsequently This photopolymer material is stiffened by light and the enveloping layer of ** ink nature is formed in the inside of a nozzle, and the front face of a nozzle plate for this at least as masking material.

[Translation done.]

EXAMPLE

[Example] Then, the example illustrated below is explained. The surface treatment process is shown in more detail, and drawing 1 shows drawing 2 and drawing 3 about the manufacturing process of the nozzle plate which makes one example of this invention, and the nozzle plate formed of this process.
[0010] The nozzle plate shown with the sign 1 in drawing It is formed by a metal, ceramics, silicon, glass, plastics, etc. Preferably Titanium, chromium, iron, cobalt, nickel, copper, zinc, tin, Single material, such as gold, or a nickel-Lynn alloy, a tin-copper-Lynn alloy (phosphor bronze), Alloys, such as a copper-zinc alloy and stainless steel, and a polycarbonate, a pulley ape phon, ABS plastics (acrylic nitril styrene-butadiene-rubber ******), a polyethylene terephthalate, two or more nozzles which are formed by the polyacetal and various kinds of photopolymer material, and become tubed from orifice partial 4b which carried out opening at funnel-like partial 4a which carried out opening to the rear-face 3 side greatly at this nozzle plate 1, and a front-face 2 side — the hole 4 is formed
[0011] In the rear face 2 of this nozzle plate 1, the dry film resist of die YARON FRA 305-38 (tradename) made from Mitsubishi rayon is first laminated as the photopolymer film 5 hardened by light, and an example. subsequently They are 4.0 kgf/cm2 to this photopolymer film 5. It heats at the temperature around 40-70 degrees C, applying a pressure, and some films 5 are made to enter the interior of a nozzle 5 from a front face to a place with a depth of 5-40 micrometers (drawing 1 (a)).
[0012] Next, ultraviolet rays are irradiated from the rear face 3 and front face 2 of a nozzle plate 1, and the optical photopolymer film 5 whole which entered into the rear face 3 of a nozzle plate 1 and the nozzle 4 is stiffened (this drawing (b)).
[0013] This process is positioned as a head end process for [the / which enters and regulates an amount d] making the eutectoid deposit 6 enter into a nozzle 4 at the following eutectoid deposit formation process.
[0014] Since the viscosity generally changes with temperature a lot, in order for this photopolymer material used in order for this deposit 6 to enter and to regulate an amount d to make some photopolymer films 5 enter in a nozzle 4 to a necessary amount of lumps containing deposit d position, the direction which managed the temperature t of heating, i.e., the amount, which fixes the pressure to apply and is applied to the photopolymer film 5 is a best policy.
[0015] In this example, the general nozzle plate T, i.e., board thickness, 80 micrometers, The diameter D of a nozzle sticks on this rear face 3 the photopolymer film 5 whose thickness is 38 micrometers using the nozzle plate 1 40 micrometers and whose length l of the tubed part of a nozzle are 35 micrometers. They are 4.0 kgf/cm2 to this. 5.0 kgf/cm2 When it heated for 20 seconds at the various temperature t, applying a pressure, the relation as temperature t and the photopolymer film 5 entered and shown in drawing 5 between amounts f was obtained.
[0016] On the other hand, in the case of this example, about the quantity of light of the ultraviolet rays (wavelength of 365nm) for stiffening the photopolymer film 5, it is 750 mJ/cm2. Light exposure was required.
[0017] Next, this nozzle plate 1 is immersed into the electrolytic solution which distributed the particle of nickel ion and water-repellent macromolecule resins, such as a

polytetrafluoroethylene, by the charge, and the eutectoid deposit 6 is formed in the front face of a nozzle plate 1, stirring liquid (this drawing (c)).
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[0019] Although there is especially no limit as a matrix of this deposit 6 and proper metals, such as nickel, copper, silver, zinc, and tin, can be chosen, what surface hardness, such as nickel, a nickel-cobalt alloy and a nickel-Lynn alloy, and a nickel-boron alloy, is size, and was moreover excellent in abrasion resistance preferably is selected.
[0020] Thereby, the particle of a polytetrafluoroethylene is a wrap uniformly about the inner circumference enclosure of a nozzle 4 to the point of the depth given from the front face 2 of a nozzle plate 1, and the front face 2.
[0021] Dissolution removal of the photopolymer film 5 which entered in the rear face 3 of a nozzle plate 1 and the nozzle 4 after this using the proper solvent is carried out. and subsequently This is heated at the temperature beyond the melting point of a polytetrafluoroethylene, for example, the temperature of 350 degrees C or more, adding a load to a nozzle plate 1 and suppressing generating of the curvature. The deposit 6 of ** ink nature which is a degree of hardness and which becomes size is formed in the front face 2 of a nozzle plate 1, and the inner skin of the nozzle to the point of the given depth (this drawing (d)).
[0022] Therefore, in the nozzle plate 1 constituted in this way, as shown in drawing 2 , the margo inferior in the nozzle 4 of the ** ink nature deposit 6 serves as an important element which determines the oscillating center A of an ink meniscus.
[0023] And if Vm and the capacity from the front face 2 of a nozzle 4 to the front face B of the ink in front of the regurgitation, i.e., the amount of an ink drop made to breathe out, are set to Vi, the opening capacity in a nozzle from the front face 2 of a nozzle 4 to the oscillating center A of a meniscus Although it can make it unnecessary for a deposit 6 to enter, for Vm/Vi to also become small, so that an amount d is small, and to stop low the piezo driver voltage for obtaining the desired amount Vi of regurgitation ink, a driver as nothing as possible, and expensive If it enters and an amount d is made small too much on the other hand, flight deflection will occur so that it may see in drawing 6 and Table 1.
[0024] On the other hand, a deposit 6 enters, in being large, the level-luffing-motion position C of the meniscus after the ink regurgitation becomes [an amount d] deep, the short supply of ink arises in the case of the level luffing motion of the foam from the front face of a nozzle 4, and the following ink drop regurgitation, and it is inducement **** in the poor regurgitation.
[0025] the following result was obtained, when the ** ink nature deposit 6 entered, prepared the nozzle plate 1 of 80 micrometers of board thickness which the amount d was boiled [board thickness] variously and changed it, the on-demand type ink jet printer which takes a piezo drive method equipped with these, the experiment which makes full breathe out the ink drop of 0.1microg/dot for 30 seconds on the response frequency of 5kHz conducted 100 times from the nozzle 4 whose path is 40 micrometers and the flight deflection in that case and the poor regurgitation counted
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d μm	Vm x10^{-14}mm^3	PZT駆動電圧 V	PZT変位ｴﾈﾙｷﾞｰ x10^{7}J	Vm／Vi	飛行曲り発生回数	吐出不良発生回数
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2	0.25	20	4.5	0.025	13	0
4	0.5	21	5.0	0.05	0	0
5	0.6	21	5.0	0.06	0	0
15	1.9	23	6.0	0.19	0	0
40	5.0	26	7.6	0.50	0	0
50	7.5	42	19.8	0.75	0	24
60	9.0	70	55.1	0.90	0	89

[0026] And when the flight deflection of an ink drop increased rapidly when the ratio of Vm/Vi Vm, i.e., the opening capacity in the nozzle 4 from the front face 2 of the nozzle plate 1 to the amount Vi of an ink drop made to breathe out to the meniscus forming face A, was less than 0.04, and this ratio exceeded 0.50 by this experiment, it turns out that the poor regurgitation occurs rapidly.

[0027] By the way, although the above was an experimental result about a nozzle 4 which has funnel-like partial 4a which carried out opening of the tubed orifice partial 4b to the front-face 2 side greatly at the rear-face 3 side, as shown in drawing 3 , it became clear to have the same inclination as a result of the experiment also about the nozzle 14 which carried out opening to the shape of a trumpet gently to the rear-face 3 side from orifice partial 14b by the side of a front face 2.

[0028] And as for the above thing, it showed [the range of 0.04 or 0.50 and / of the deposit 6] Vm/Vi that what is necessary is to enter and just to define an amount d so that it might become the range of 0.05 or 0.35 more preferably.

[0029] Drawing 4 shows the 2nd example of this invention about the surface treatment method of a nozzle plate 1.

[0030] This method makes the front face 2 of a nozzle plate 1 carry out the pressure welding of the elastic plates 7, such as rubber, first with the necessary press force, and only the amount which necessary enters in a nozzle 4 and is equivalent to an amount d makes the part enter [method]. And next, a dry film resist or the proper plasticizer 8 is applied to the rear-face 3 whole of a nozzle plate 1 as masking material 8 including nozzle 4 portion (drawing 4 (a)).

[0031] Subsequently, when ultraviolet rays are irradiated from a rear face 3, this is stiffened, when a dry film resist is used as masking material 8, and other plasticizers are used, after solidifying this by heating or the usual dryness processing, the elastic material 7 is removed from the front face 2 of a nozzle plate 1 (drawing 4 (b)).

[0032] And next, this nozzle plate 1 is immersed into the electrolytic solution which distributed the particle of a water-repellent macromolecule resin by the charge. or [forming in the front face 2 the enveloping layer 9 of the ** ink nature which consists of an eutectoid deposit] — or The macromolecule water repellent of a fluorine system is given to the front face 2 of a nozzle plate 1 by the sputtering method or the dipping method (drawing 4 (c)), and it is made to carry out dissolution removal of the masking material 8 at the end from the rear face 3 of a nozzle plate 1 using proper processing liquid (drawing 4 (d)).

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] (a) Or (d) is drawing having shown the forming cycle of the nozzle plate which makes one example of this invention.
[Drawing 2] It is the expanded sectional view of the important section of a nozzle plate having shown one example of this invention.
[Drawing 3] It is the expanded sectional view of the important section of a nozzle plate having shown other examples of this invention.
[Drawing 4] (a) Or (d) is drawing having shown the forming cycle of the nozzle plate which makes other examples of this invention.
[Drawing 5] It is drawing in which having entered in the nozzle of temperature and a photopolymer film and having shown the relation with an amount.
[Drawing 6] It is drawing having shown the relation of each number of times of generating with poor Vm/Vi, flight deflection, and regurgitation.
[Description of Notations]
1 Nozzle Plate
4 Nozzle
5 Photopolymer Film
6 Eutectoid Deposit
7 Elastic Plate
8 Masking Layer
9 ** Ink Nature Enveloping Layer
Vm Opening capacity in a nozzle from the front face of a nozzle plate to a meniscus forming face
Vi The amount of the ink drop made to breathe out